

# ADEPT Sounding Rocket One (SR-1) Flight Experiment Overview

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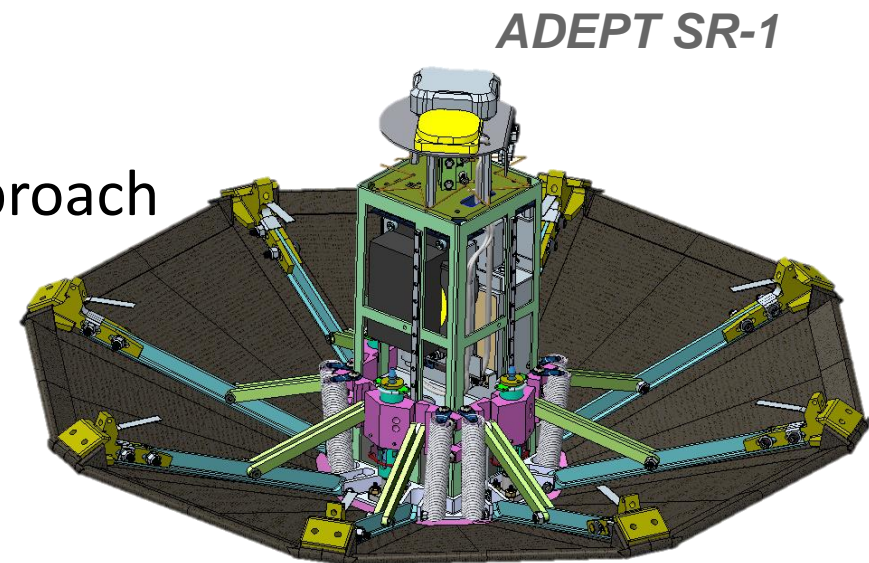
Session 2.03 Systems and Technologies for Landing on Planets, the Moon, Earth and Small Bodies

# What is this talk about?

*My goal is for you to walk away with an understanding of the ADEPT technology, overview of the SR-1 flight experiment, SR-1 system description and capabilities, development test summary, and longer term mission infusion*

## Presentation Outline

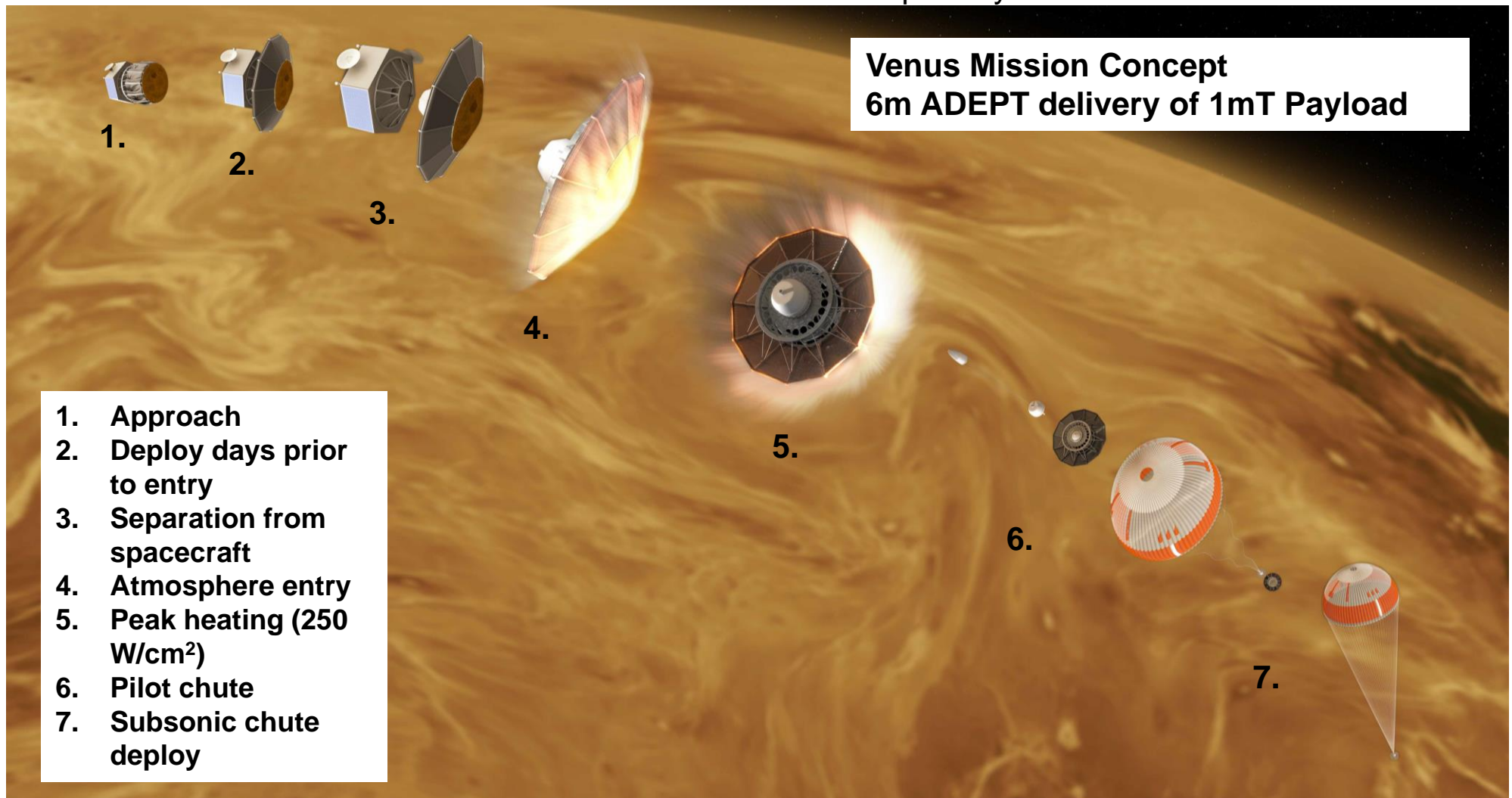
- ADEPT Technology overview
- SR-1 Flight Experiment Con-Ops
- Flight Experiment Success Criteria
- SR-1 Subsystem Description
- Risk-based Development Testing Approach
- ADEPT technology infusion options



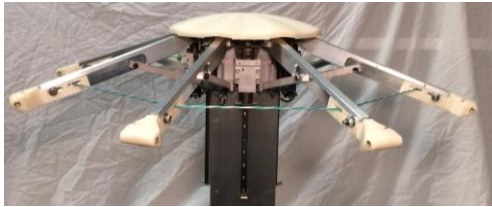
# Adaptable Deployable Entry and Placement Technology (ADEPT)

**ADEPT is a novel Entry, Descent, and Landing (EDL) architecture enabled with multi-layer, flexible woven carbon fabric**

- Stowed at launch and deploys prior to atmosphere entry
- Serves as both heat shield and primary structure

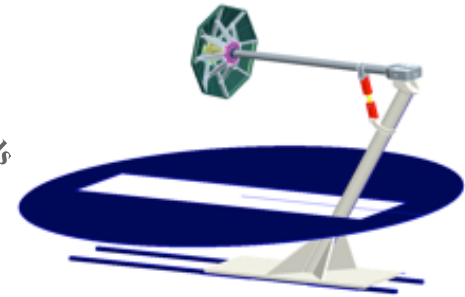
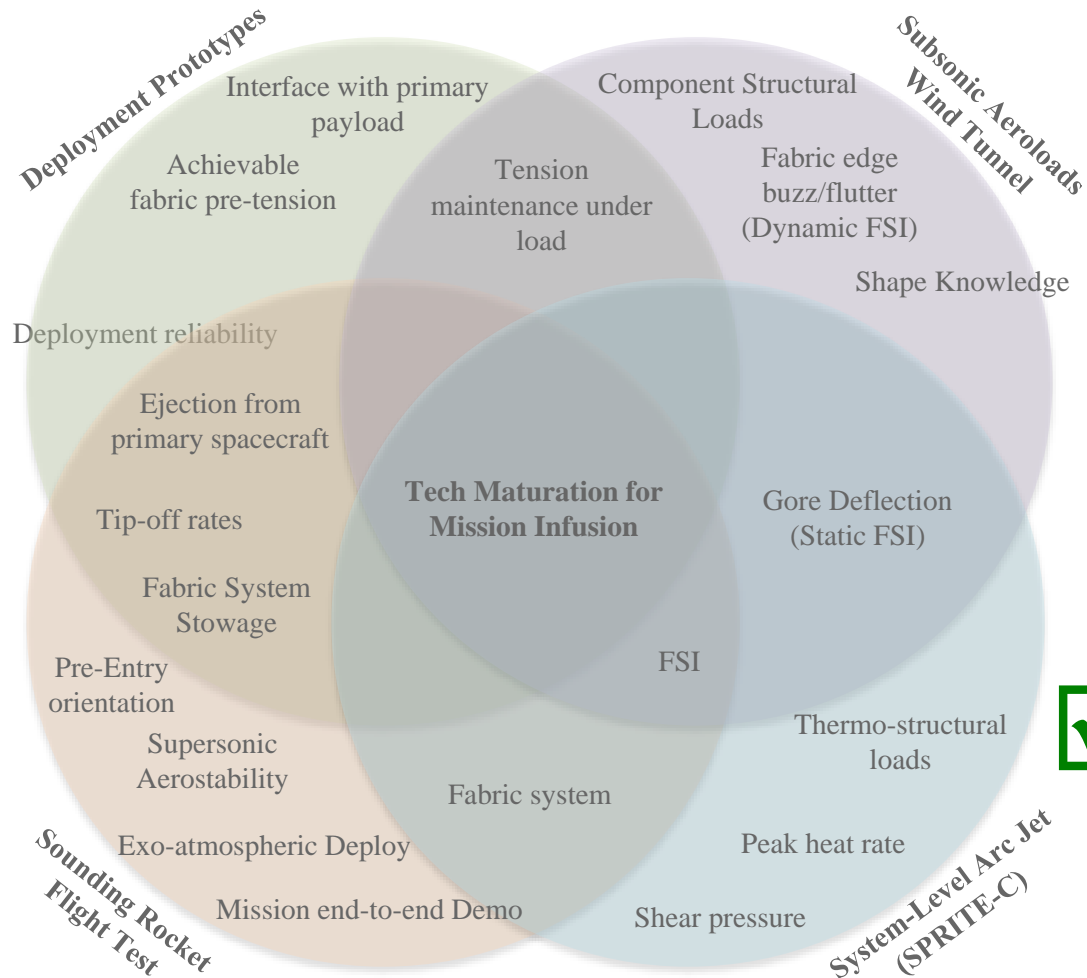


# Technology Maturation Strategy



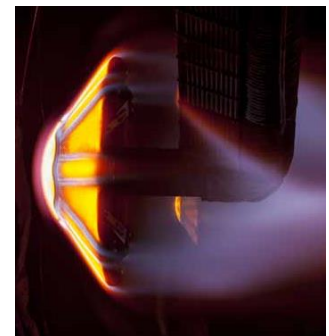
**Deployment Prototype Demonstrator (FY15-16)** ☒

**SR-1 Sounding Rocket Flight Test (FY17-18)** ☐



**7x10 Wind-tunnel Aeroloads test (FY15)** ☒

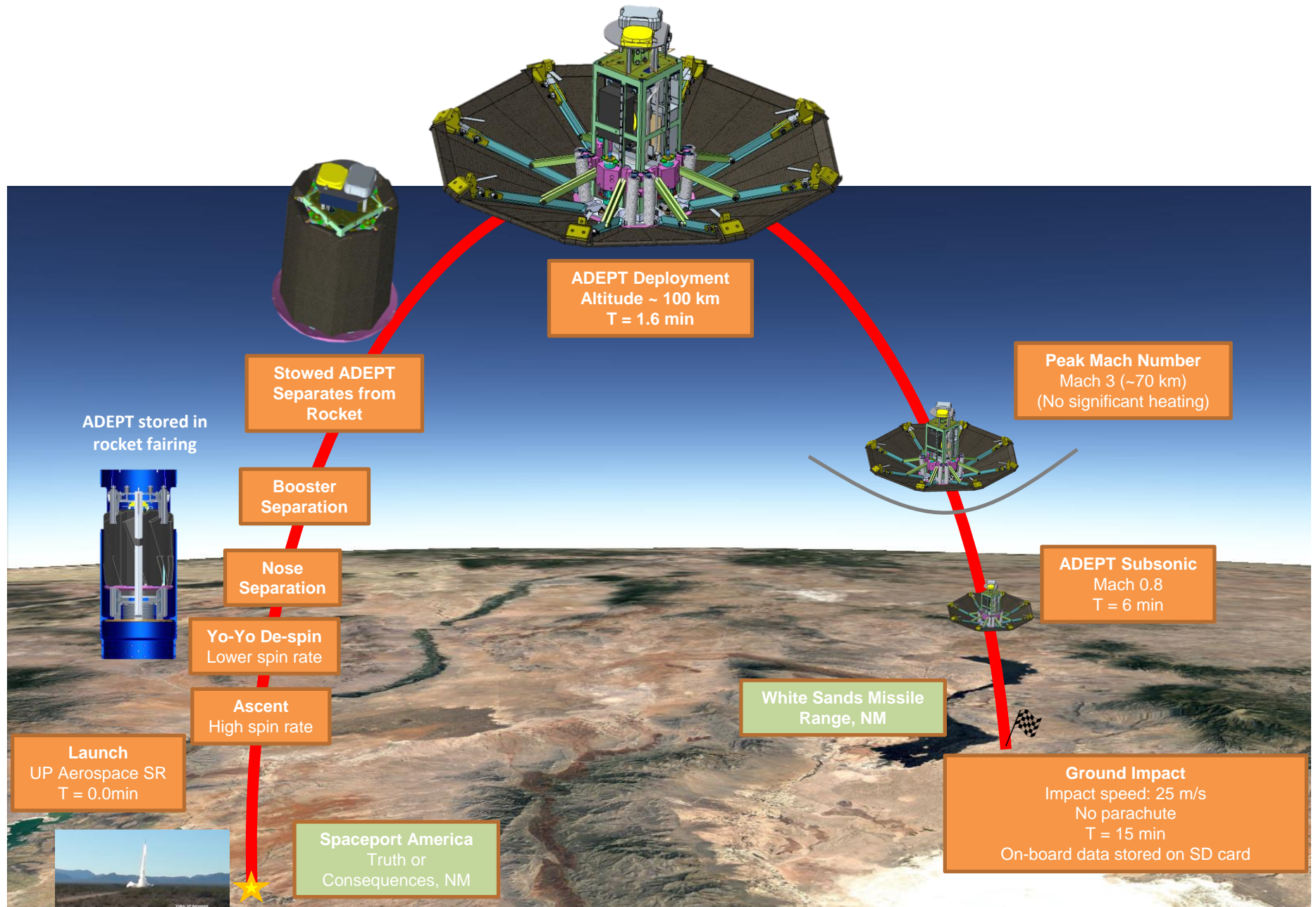
**SPRITE C System level Arc-jet testing (FY15)** ☒



- **GCD approved (Aug 2016) SR-1 Sounding Rocket Flight Experiment**
  - Demonstrating exo-atmospheric deployment and supersonic stability
  - Aggressive schedule -> 1 year between PDR and Launch!
  - Launch in late CY 2017



# SR-1 Flight Experiment Overview



# SR-1 Animation movie

# ADEPT SR-1 Flight Experiment

## Key Performance Parameters and Success Criteria

### **KPP-SR1-1: *Exo-atmospheric deployment to an entry configuration***

**Project Goal:** Full, locked deployment before reaching 80 km altitude on descent, to 70° forebody cone angle

### **KPP-SR1-2: *Aerodynamic stability without active control***

**Project Goal:** Does not tumble before ground impact;

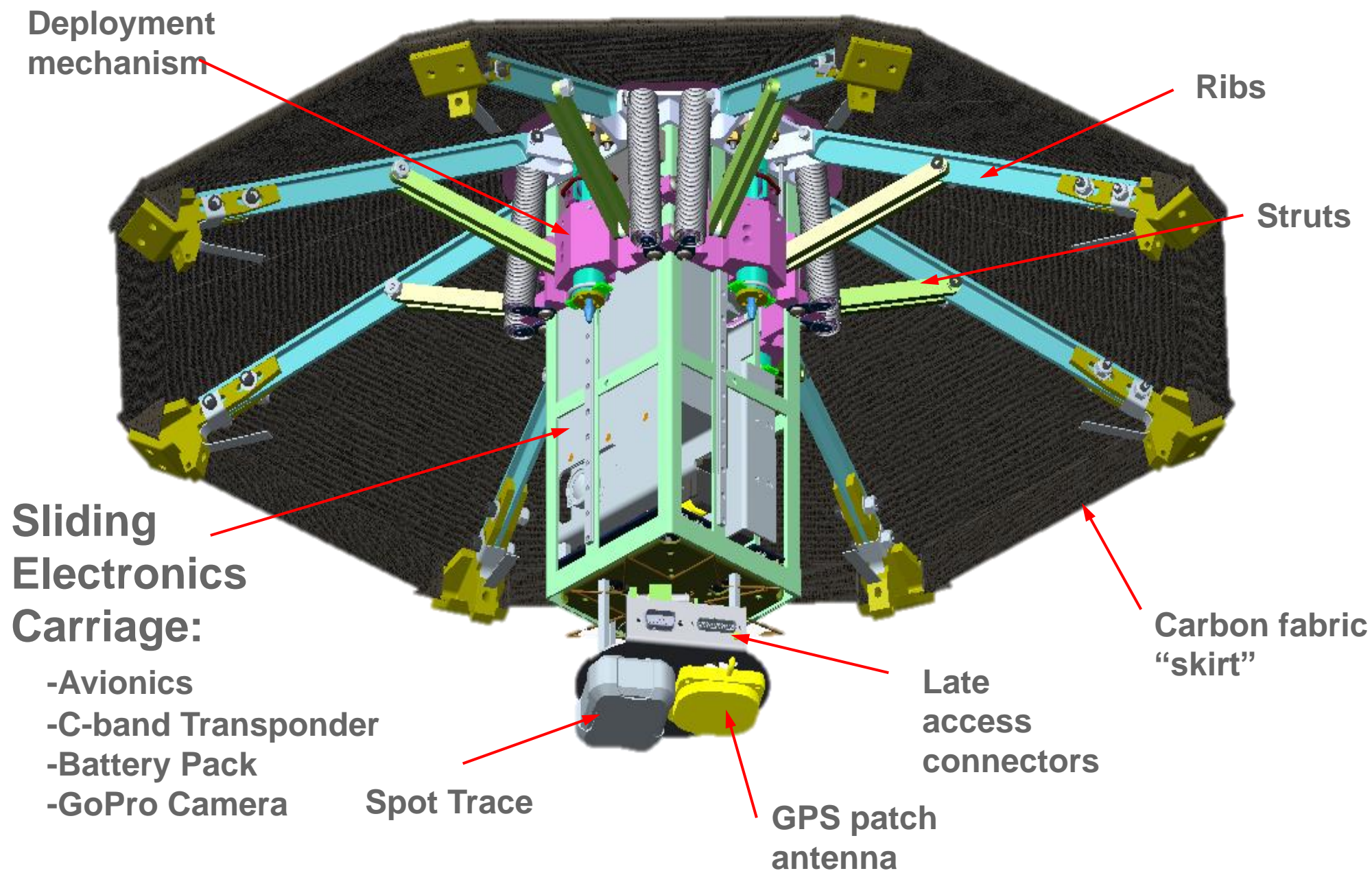
### **SR-1 Flight Test Success Criteria**

- A. ADEPT separates from the sounding rocket prior to apogee
- B. ADEPT does not re-contact any part of the launch vehicle after separation
- C. ADEPT reaches an apogee greater than 100 km.
- D. ADEPT achieves fully deployed and locked configuration prior to reaching 80 km altitude on descent
- E. Obtain video of deployed ADEPT to observe fabric response and flight dynamics during entry
- F. Obtain data necessary to reconstruct ADEPT 6 DOF descent trajectory

#### **▪ Data Sources to Verify Success Criteria**

- On-board data (Avionics data and GoPro camera) stored for post-launch recovery
- White Sands Missile Range (WSMR) ground tracking data

# SR-1 Layout and Subsystems





# SR-1 Electronics Carriage

## GoPro Camera

- Hero 3
- Data ( $\mu$ SD)

## Affordable Vehicle Avionics (AVA)

- IMU
- Accelerometers
- GPS
- Data ( $\mu$ SD)

## EPS Board

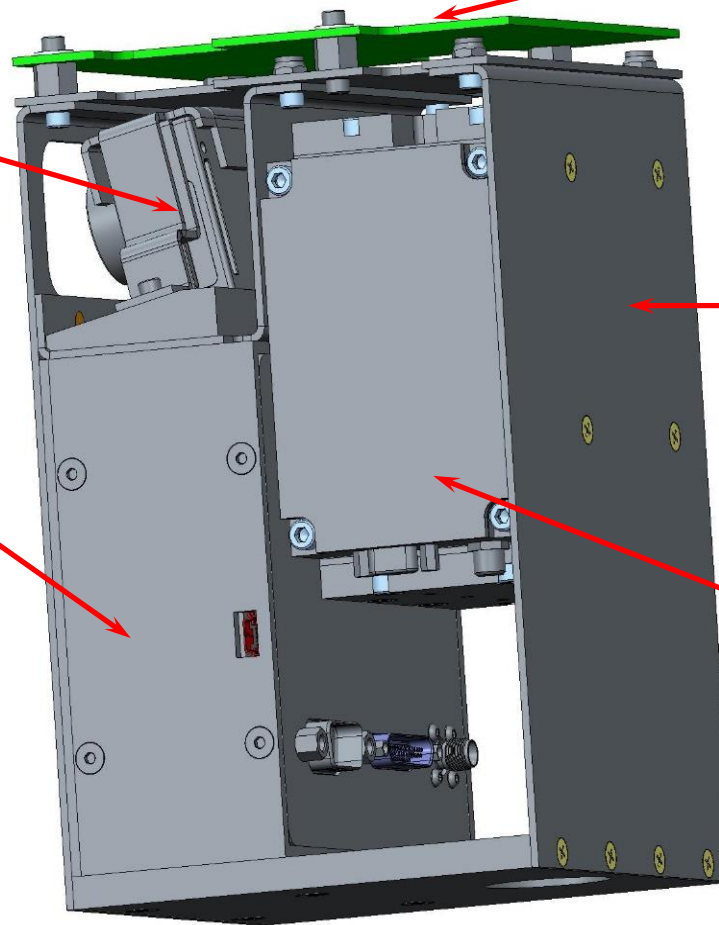
- Power regulation and distribution
- Simple events timing
- LED event indicator

## Battery Pack (Behind Transponder)

- Panasonic Li-Ion Cells
- Size 18650
- Qty 6

## C-Band Transponder

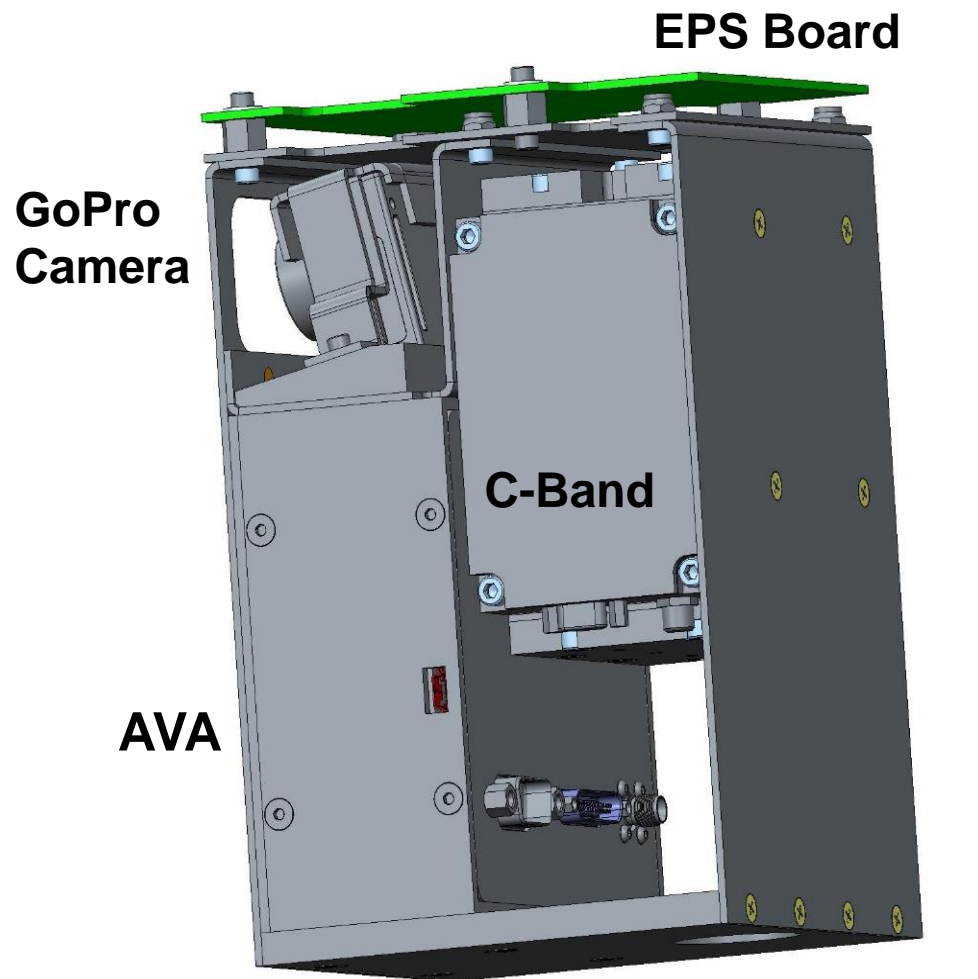
- TTC 520-XPDR
- 25W Unit



## Electronics Carriage

- Supports on-board data collection and storage
- Supports Ground Tracking facilities

# How SR-1 Data Sources will be Used



GoPro® Camera on Launch Vehicle  
Deployment Confirmation LED

USE: Confirm full and locked deployment

Primary IMU

Backup IMU

Magnetometer

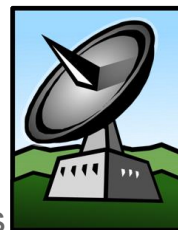
GPS Receiver

GoPro® Camera on ADEPT

C-Band Transponder

Atmospheric Pressure and  
Temperature Measurement with  
Weather Balloon

USE: Trajectory reconstruction for dynamic stability assessment and FF-CFD simulation validation



WSMR Ground  
Tracking Stations

SPOT Trace®  
C-Band Transponder  
Ground Tracking Radar

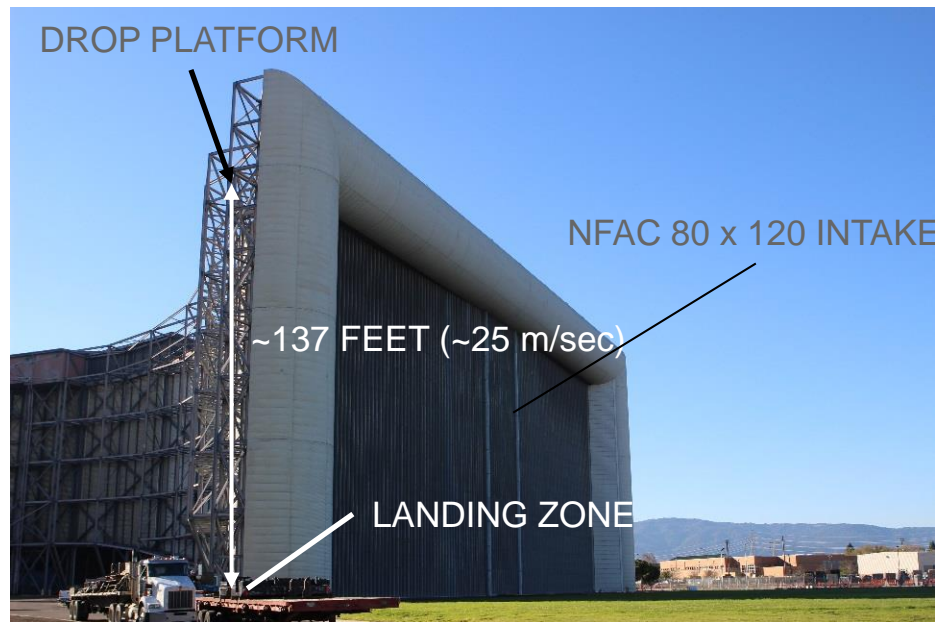
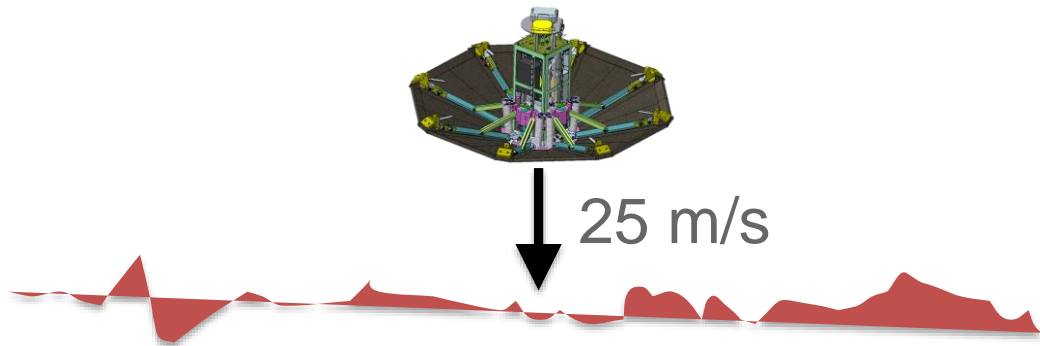
USE: Locate SR-1 after ground impact

## Electronics Carriage

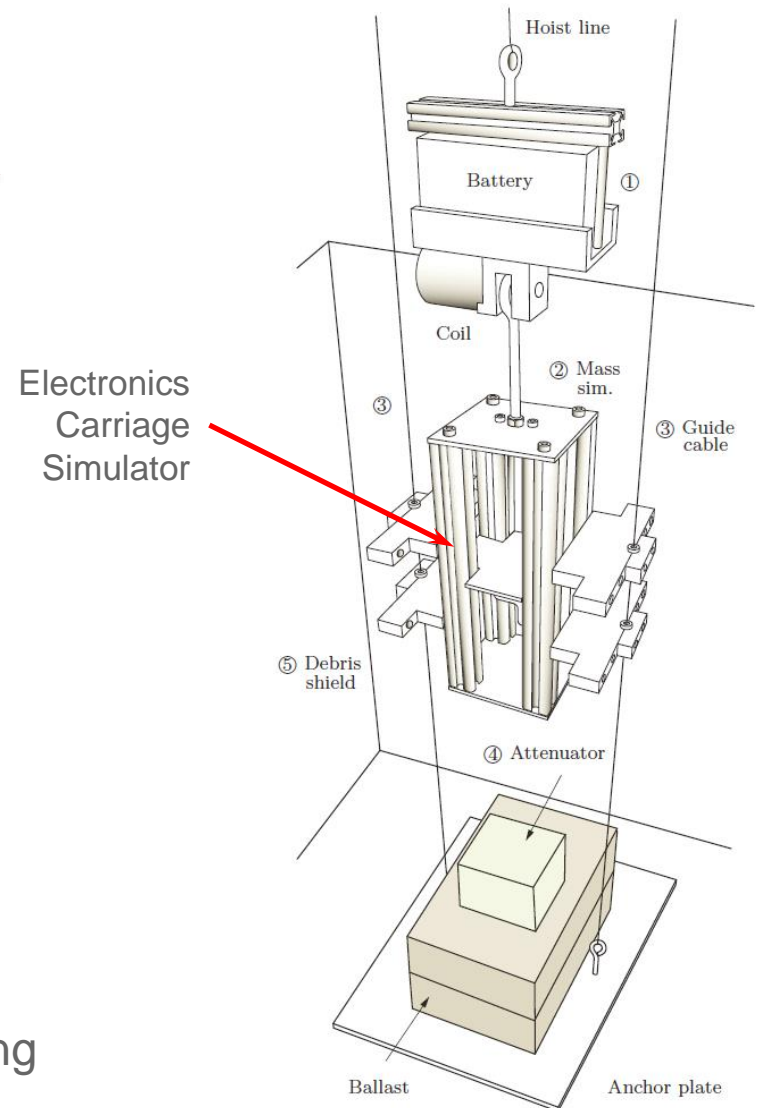
- SD cards must survive ~ 25 m/s (54 mph) impact velocity!

# Shock Testing of SD Cards

## (Drop Testing to Assess Impact Survival)



- Drop test location allows matching of flight article impact velocity
- Drop test configuration allows controlled impact testing of impact attenuator and SR-1 electronics carriage



# Shock Testing of SD Cards

## (Drop Testing to Assess Impact Survival)

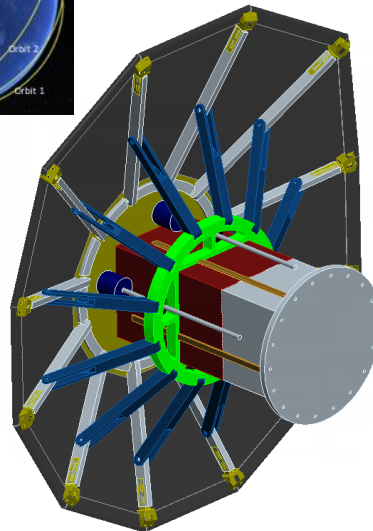
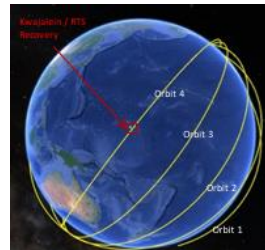


# Summary

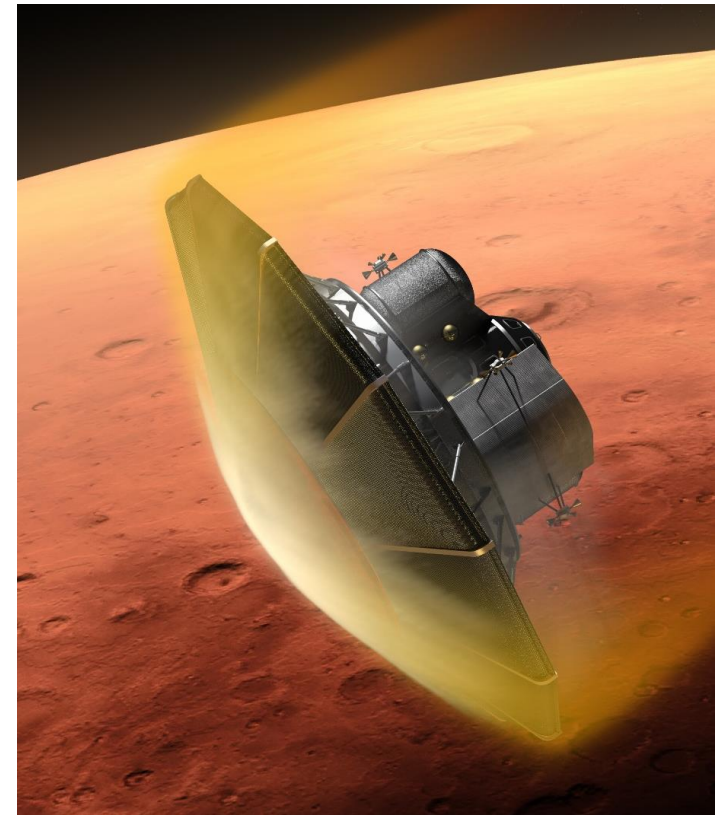
- **ADEPT SR-1**
  - “First step” Flight experiment demonstrating ADEPT
- **Looking beyond SR-1...**
  - Small spacecraft by using an ADEPT EDL system to overcome volume limits
  - Secondary payloads to Venus, Mars, and LEO entry are feasible near-term applications
  - Nano-ADEPT provides technology development extensible to large ADEPT applications



1m ADEPT Mars Lander  
Malin SSS Concept (2014)



1.5m Lifting ADEPT LEO Flight Test Concept  
NASA Ames & JHU-APL Study (2016)



16m Lifting ADEPT Human Exploration

